Nutrition in Critically ill Burns & Trauma

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- Any body who needs *constant monitoring and therapy* to prevent and treat organ-system dysfunction is a critically ill patient

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- Critically ill burns & trauma patients have a *very high metabolic response* and are potentially on the verge of decompensation of organ function

nutrition in critically ill burns & trauma

- Type of burn injury

  injury from flame

  injury from hot liquids

  injury from radiation

  injury from chemicals

  injury from electrocution

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  1st degree (epidermal)

  2nd degree (superficial dermal & deep dermal)

  3rd degree (full thickness) & 4th degree (beneath the skin upto bones)

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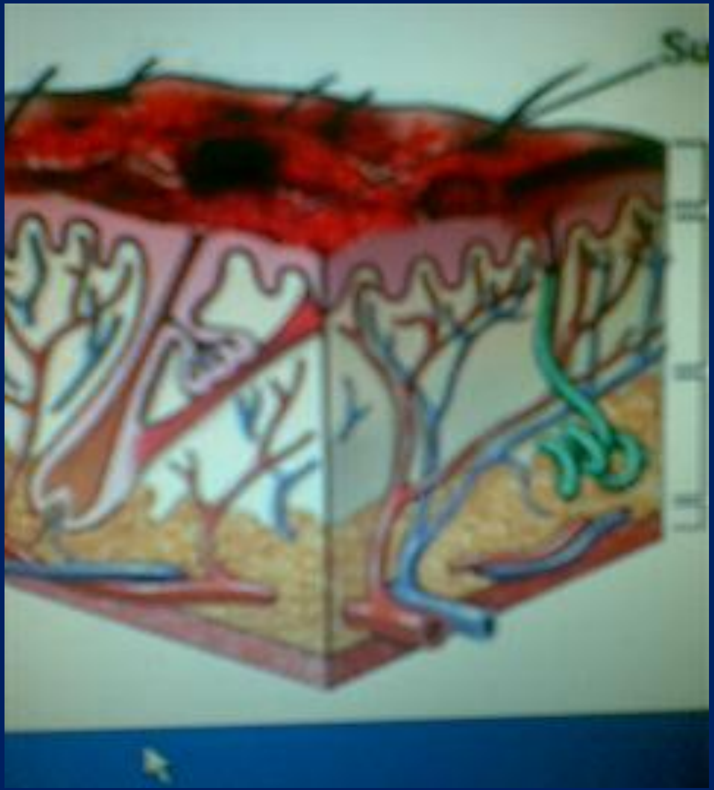

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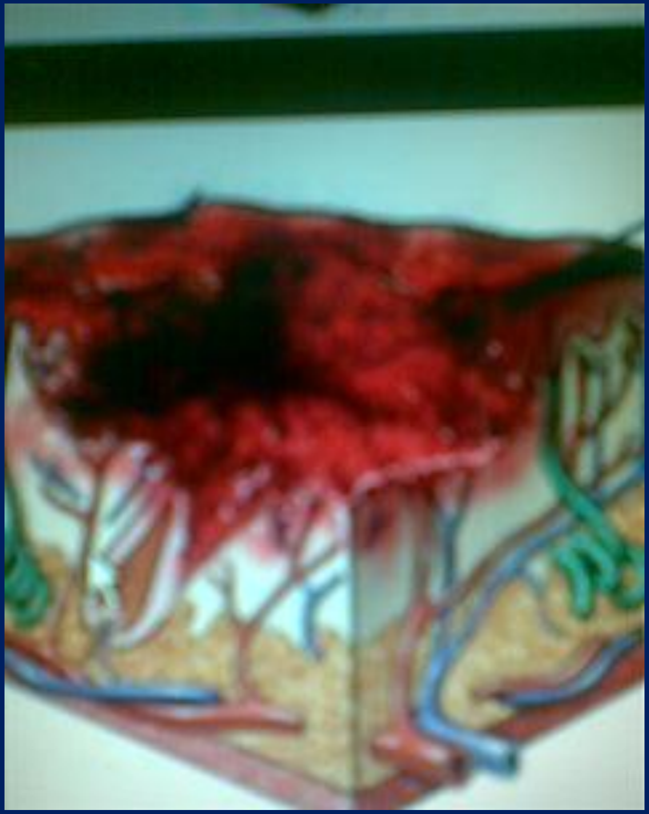

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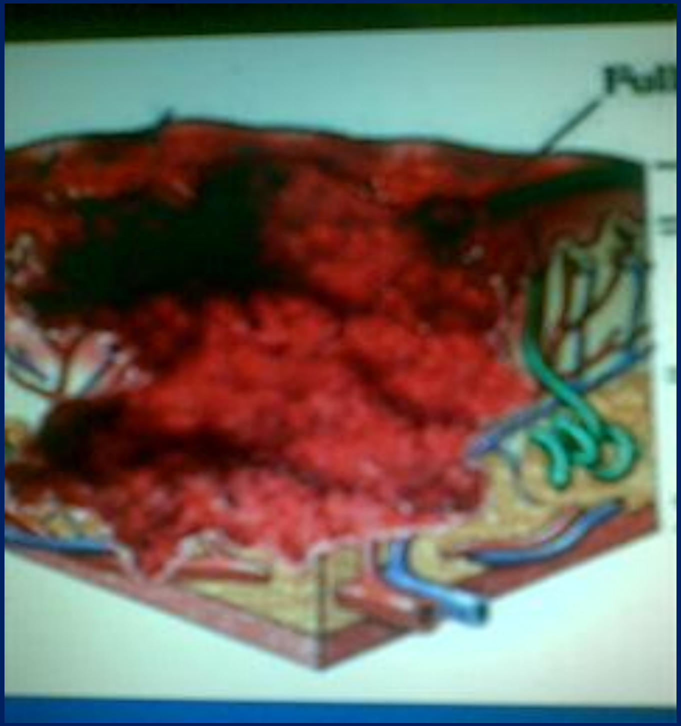

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metabolic changes in burns & trauma

- ebb phase (12 –24h):↓ metabolic rate, ↓temp,↓ O2 consumption, ↓BP, vasoconstriction
- flow phase(beyond 24 h until recovery): hypercatabolism, utilisation of fat as energy source
- anabolic phase (onset of recovery): improved appetite, diuresis, stable vital signs

metabolic changes in burns & trauma

- insulin release & insulin resistance: this can persist for > 12 months and impaired glucose tolerance for > 3 yrs
- plasma catecholamines:10-50 fold increase in major burns and can stay for > 3 yrs
- Plasma corticosteroids: similar
- cytokines: rise immediately after burns and comes down only after one month
- acute phase proteins : altered 5-7 days post burn

metabolic response to burns & trauma

endocrine response breaks down:

fatty deposits → fatty acids

liver/ muscle (glycogen) → glucose

muscle (amino acids) → amino acids

metabolic response to trauma & burns

- hypermetabolism
- insulin resistance
- lipolysis
- accelerated protein catabolism

metabolic response to trauma

measured REE(mREE) is greater than *estimated* REE(eREE)

in major trauma it may go up and last for 3-4 weeks following trauma

nitrogen loss in critically ill

- normal………………. 6-9 gms
- elective surgery.. 10 gms
- infection…………… 15 gms
- sepsis………………… 18 gms
- trauma……………… 21 gms
- burns………………… 28 gms

nitrogen loss in critically ill

- 1 gm N2 = 6.25gm protein
  = 31.25gm muscle mass
- 15 gms of N2 = 93.9gms of protein
  = 458.75gms of muscle mass
- 21 gms of N2 = 131.5 gms of protein
  = 656.25 gms of muscle mass
- 28 gms of N2 = 175 gms of protein
  = 875 gms of muscle mass

energy requirement in burns & trauma

Long formula:

BEE × activity factor × injury factor

male BEE = 66.6 † 13.8 W † 5 H – 6.8 A

female BEE = 655 † 9.6 W † 1.9 H – 4.7 A

W= weight(kg), H= height(cm), A= age(yrs)

activity factor: 1.2 (if confined to bed), 1.3 (if out of bed)

injury factor: 2.1 for severe thermal burn

energy requirement in burns & trauma

Curreri formula:

age (16-59 yrs): Kcal/day = 25W † 40 BSAB

age (> 60 yrs): Kcal/day = 20 W † 65 BSAB

(W = weight in kg, BSAB = % body surface area burnt)

a 50 yr old 60 kg person with 30% burn will need :

(25 × 60) † (40 × 30) = 1500 † 1200 = 2700 Kcal daily

energy requirement in burns & trauma

- Direct colorimetry uses *measured* O2 consumption Co2 producion to determine the REE (MREE)

MREE = (3.9 × Vo2) † (1.1 × VCo2) × 60 × 1/BSA

energy requirement in burns & trauma

formula for paediatric patients:

WHO

RDA (recommeded dietary allowance)

Curreri junior

Galveston infant

Galveston revised

Galveston adolescent

resting metabolic rate in burns at 30°C

- exceeds 140 % of normal at admission
- reduces to 130 % once wounds are fully healed
- Further reduces to 120 % at 6 months and
- 110 % at 1 yr

energy requirement in burns & trauma

administration of calories and protein:

- CHO should not be administrated @ > 5-7 mg/ kg / min
- fat should not be more than 30 % of the caloric requirement and would be around 2.5 gm / kg / day
- protein up to 1.5 - 2 gms /day ; in renal failure : 0.5 gm/day

- nutrition should be started within first 48 hrs of injury or admission and average intake delivered within 1st wk should be 60 – 70 % of total energy requirement

early enteral nutrition in burns & trauma

Early enteral nutrition provided within 24 h of injury or intensive care unit admission, significantly reduces mortality in critically ill patients; a meta-analysis of randomised controlled trials.

Gordon S. Doig, Philippa T. Heighes, Fiona Simpson, Elizabeth A. Sweetman, Andrew R. Davies. Intensive Care Medicine, December 2009, vol 35, issue 12, p 2012- 2027

antioxidant micronutrients in major trauma and burns

major trauma & burns have an

- increased free radical production which is proportional to severity of injury
- negetive trace element balances : selenium, zinc, vit C & E
  status are altered in all injured patients
- Patients in major burns have copper deficiency
- In major burns, high dose vit C for 24 h achieve reduction in
  resuscitation fluid requirement by endothelial anti oxidant
  mechanisms both in animal models and in one human study

Berger M M, Dept of CCU & Burn Centre, Lausanne, Switzerland

immunity in major trauma and burns

- trauma docs the 'increased succeptibility' of patients to infection (mechanism not known)
- Burns decreases immunity and major cause of morbidity and mortality in burns is sepsis

Immuno nutrition in major trauma and burns

- specific nutrients such as arginine,omega-3 PUFA, glutamine and nucleotides have been shown to modulate host response in animals but there is inconsistent clinical evidence
- Theory:

  arginine stimulates T lymphocytes and provides a substrate for generation of NO

  omega-3 PUFA promotes synthesis of favourable prostaglandins. They are anti inflammatory agents

  long chain omega-3 FA decreases production of eicosanoids, cytokines and adhesion molecules

  nucleotides nonspecifically enhances immune competence

assessment of energy requirement in burns & trauma

subjective global assessment (SGA):

- weight loss
- food intake
- presence of significant g.i. symptoms
- functional status / energy level
- metabolic demand of the underlying disease states

on examination:

- depletion of subcut fat
- quadriceps and deltoid muscle wasting
- oedema
- ascites

each one is assigned category A (well nourished), category B (mildlymalnourished), and category C (severely malnourished)

loss of lean body mass in burns

- 10 % loss of lean body mass decreases immune function
- 20% loos decreases wound healing
- 30 % loss leads to increased risk of pneumonia
- 40% loss leads to death

protein loss can remain upto one year

a severely burnt patient can develop cachexia in one month

enteral nutrition in trauma & burns

Principles:

- Use the oral route if GIT is functional
- Initiate nutrition thru enteral route if pt is not expected to be on a full oral diet within 7 days
- If enteral route is contraindicated/ not tolerated, use PN within 48 h
- Administer at least 20% of calories and protein requirement enterally while reaching the goal with PN
- Maintain PN until pt tolerates 75% of calories thru enteral route and EN until he/she tolerates 75% calories through oral route

contraindication to EN

- Intractable vomiting , diarrhoea refractory to medical manag.
- distal high output intestinal fistula
- GI obstruction , ischaemia
- diffuse peritonitis
- severe shock, haemodynamic instability
- severe GI haemorrhage
- severe short bowel syndrome
- severe GI malabsorption
- inability to access GI tract
- paralytic ileus

Complications of EN

- diarrhoea
- nausea & vomiting
- constipation & faecal impaction
- aspiration pneumonia
- hyponatremia , overhydration
- hyper natremia, dehydration
- hypokalemia,hypomagnesemia, hypophosphatemia
- hyperkalemia
- Re-feeding syndrme

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Refeeding syndrome

- Refeeding in nutritionally depleted patients (≥ 10% loss of body weight over ≤ 6 months) should be done carefully so as not to overload a metabolic system that has adopted to minimal or no food intake

  intake should be increased step wise over a week / 10 days

  hypo phosphatemia occurs when tissues begin to rebuild and is problematic if inadequate phosphate is given in the food. It causes major muscle weakness and glucose intolerance

monitoring for nutrition

- daily / alt days / biweekly:
  - BUN, serum creatinine
  - plasma electrolytes
  - glucose, Ca, Mg, inorganic phos,
  - Hb, WBC, platelets,
  - triglycerides and transaminases
- serum albumin: t ½ 14 – 20 days
- transferrin: t ½ 9 days
- pre albumin: t ½ 1 – 2 days
- retinol binding protein
- nitrogen balance

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nitrogen balance

(protein intake/ 6.25) – (UUN † 4.0) gms

over 12/24 h

0 to - 5 ….. moderate stress

< - 5 ……… severe stress

parenteral nutrition in trauma & burns

- advantages:
  - direct mixing in blood
  - no risk of aspiration
- disadvantages:
  - intestinal mucosal atrophy
  - catheter related sepsis
  - expensive

Summary of nutrition in trauma & burns

- trauma and burns are hyper metabolic states and protein loss is maximum in comparision to any other stress and this state persists for a long time
- early enteral nutrition is key to successful out come in these conditions
- monitoring of nutritional status and complications of nutrition delivery are extremely important
- parenteral nutrition should be started if enteral nutrition is not possible within 48 h

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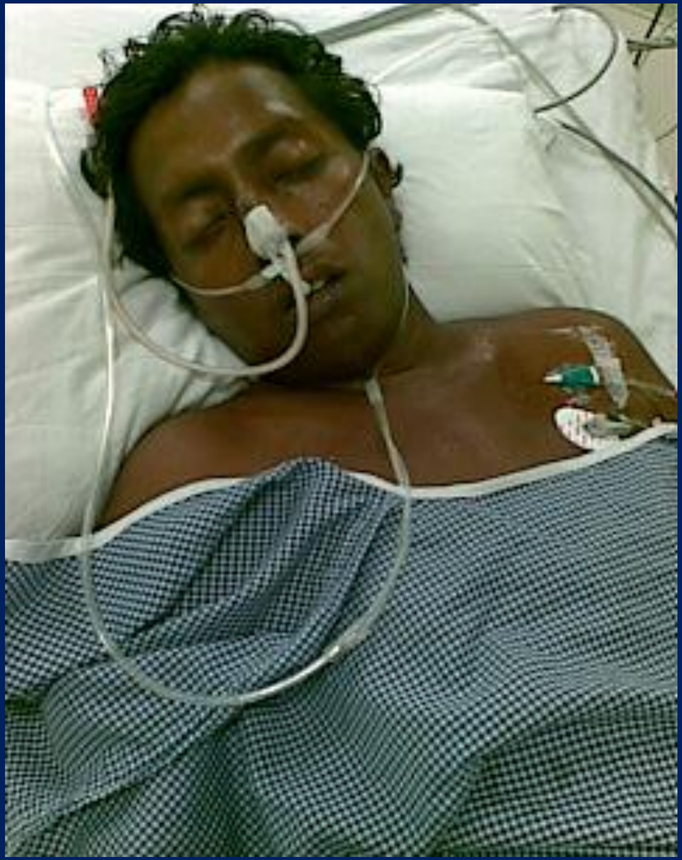

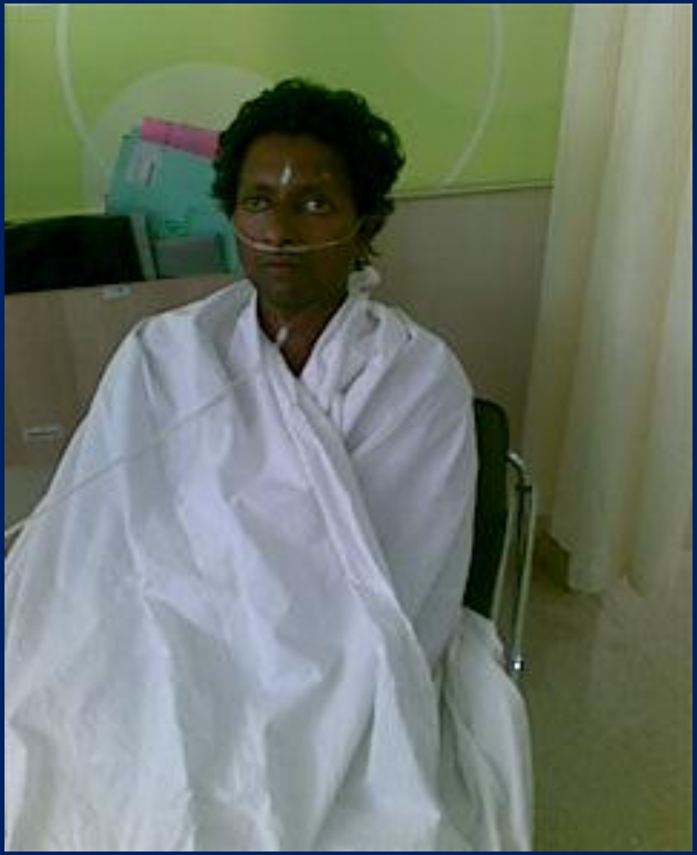

Thank you